§ 7. Helium and Hydrogen Retention of Plasma Facing Wall of LHD

Hino, T., Yamauchi, Y., Satoh, S., Hirohata, Y. (Hokkaido Univ.)
Komori, A., Noda, N., Sagara, A., Masuzaki, T., Ashikawa, N., Ohyabu, N., Motojima, O.

In LHD, both helium and hydrogen gas have been employed for main discharge shots and glow discharge cleanings. Then, the recycling of helium or hydrogen is not ignored in the main discharge of hydrogen or helium, respectively. However, the details of retained amount of helium or hydrogen in plasma facing walls have not been investigated yet. For this purpose, the amount of retained helium or hydrogen in the stainless steel used for plasma facing walls of LHD was examined by using a glow discharge apparatus. In the experiments, helium glow discharge and hydrogen glow discharge were repeated and the retained and desorbed amounts of helium and hydrogen were measured during each the discharge by using residual gas analysis, RGA. The discharge time was taken 2 hr. The wall temperature was kept room temperature. In addition, the desorbed amount of impurity was similarly measured.

Figure 1 (a) shows the retained amounts of hydrogen and helium versus discharge number, where the hydrogen discharge was initially conducted. The amount of retained hydrogen was reduced by approximately 30% by the helium discharge. The amount of retained helium was approximately 2 orders magnitude smaller than that of hydrogen. The reduction of retained amount of helium by the hydrogen discharge was very small, and the ion impact desorption of helium by hydrogen was not effective.

Figure 1 (b) shows the retained amount of helium or hydrogen versus discharge number, where the helium discharge was initially conducted. In this case, the amount of retained helium was one order larger than the case of Fig.1 (a). The retained amount of hydrogen was approximately 5 times smaller than that of Fig.1 (a). Again, the helium retention was not reduced by the hydrogen discharge.

The above results suggest that the retention of helium or hydrogen is limited if hydrogen or helium is already implanted. The ion impact desorption of helium by hydrogen can be ignored, although the hydrogen can be removed by the helium ion irradiation. In the wall of LHD, it is conceived that the amount of retained helium is comparable with or smaller than that of retained hydrogen. Thus, the walls have to be significantly conditioned before hydrogen or helium discharge is conducted after helium or hydrogen discharge shots, respectively.

The amounts of desorbed impurities such as CO, CH_4, H_2O and CO_2 were measured by repeating hydrogen and helium discharges. Figure 2 shows the amounts of desorbed impurities versus discharge number for the discharges with initial discharge of hydrogen. The amounts of desorbed impurity gases significantly decreased after the 2nd or 3rd discharge. This tendency was similar for the discharges with initial discharge of helium. The ion implantation depth is only several nm in the present glow discharge. Thus, it is regarded that the impurities within the depth of several nm can be removed by the helium or hydrogen discharge of a few hours.

In order to reduce the retention of helium or hydrogen, surface heating of walls may be useful. For this purpose, similar experiments will be conducted for the wall with an elevated temperature.

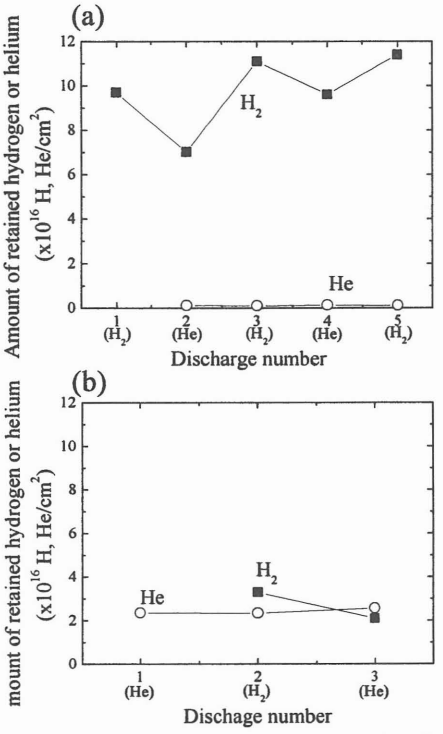

Fig.1 Retained amounts of hydrogen and helium versus discharge number.
(a) Discharges with initial discharge of hydrogen
(b) Discharges with initial discharge of helium

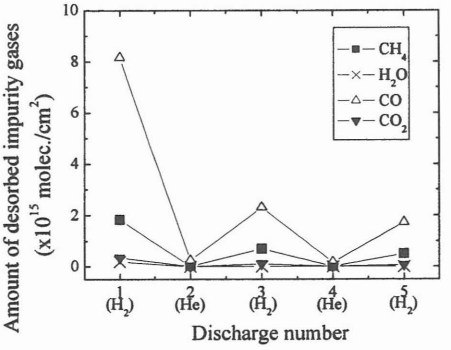

Fig.2 Amount of desorbed impurities versus discharge number for discharges with initial discharge of hydrogen.